ENVIRONMENTAL
Fact Sheet

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

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Managing Gas Emissions at Municipal Solid Waste Landfills

Background

Municipal solid waste (MSW) landfills typically generate significant volumes of various gases during their active life and for a period of time after closure. Most of the gas generated is methane and carbon dioxide with smaller amounts of volatile organic compounds (VOCs). The gas is emitted into the atmosphere and can travel long distances in the soil. Landfill gases, VOCs in particular, contribute to air pollution and the formation of ground-level ozone. Methane, a colorless and odorless gas, is highly explosive at a concentration of 5% to 15% in air and can accumulate to dangerous levels virtually undetected. Therefore, at municipal solid waste landfills it is necessary to monitor the migration of methane gas to ensure the safety of both on-site and off-site structures and personnel, and it may be necessary to control the landfill gas for either safety reasons or to abate air pollution. This fact sheet provides guidance on how to comply with all (as of December, 1997) state, federal Clean Air Act and federal RCRA Subtitle D regulations and provides help in planning for effective landfill gas management.

Control of Methane - Waste Management Division and Federal RCRA Subtitle D Requirements

Gas can travel long distances in the soil adjacent to a landfill, especially after closure when a cap can act as a barrier to the upward movement of gas. Pressure building within the landfill can force the gas out of the sides and through permeable layers within the soil. In this way, methane (the predominant explosive component of the gas) can accumulate in nearby structures, particularly through utility penetrations in foundation walls. The explosive range for methane in air is between 5% and 15%, a concentration that can accumulate rapidly, representing a significant health and safety threat. Methane is odorless and colorless and can only be detected with monitoring devices. Therefore, it is necessary to monitor the migration of methane and to have a contingency plan in place to deal with any potentially unsafe condition that may arise. The following is guidance on how to comply with federal and state requirements for the management of methane gas from a safety standpoint. Also, guidance for recognizing situations where gas migration problems may arise is presented.

- Design plans for landfill closure must contain a gas control / venting system which meets the requirements of the Department of Environmental Services (DES), Air Resources Division (ARD) regulations (see below for more information). The gas control system may consist of passive vents, passive flares or a system which actively collects and destroys the gas emissions. Passive vents and flares have typically been installed at a frequency of one or more per acre of landfill cap. If the gas control system is active, the

number and spacing of gas wells is based on a calculation of the radius-of-influence of each well. The design plans must show the location of each vent, as well as the vent detail.

- Design plans must also show locations and details of gas monitoring wells to be placed around the landfill with particular attention paid to sensitive areas (e.g. close to property line or structures). If wells are not to be placed in certain areas, then the landfill owner must demonstrate how safety requirements are being met. Gas monitoring wells are typically located in the soil above the ground-water table and placed such that the most transmissive soil layer can be monitored.
- A gas monitoring plan must be provided as part of either an operating plan or post-closure monitoring and maintenance plan which addresses the following items. A permittee must monitor for methane concentration in soil monitoring wells and in the ambient air (breathing zone) at the property line at the frequency specified in the facility's solid waste permit. If the landfill is subject to the requirements of 40 CFR 258, Subtitle D of RCRA, then the frequency of monitoring shall be no less than quarterly [see DES Fact Sheet **WMD-SW-21** (1996) for information on which landfills are subject to 40 CFR 258]. Monitoring is performed to ensure that methane concentrations have not exceeded 25% of the lower explosive limit (LEL) in structures on or off-site; 50% of the LEL in the soil at or beyond the property line; and have not exceeded 10% of the LEL in the ambient air (breathing zone) at or beyond the property line. For closed landfills, gas monitoring shall take place during the entire post-closure monitoring period [see DES Fact Sheet **WMD-SW-28** (1996) for post-closure care of landfills].
- If the above levels of gas are exceeded, the landfill owner / operator must notify DES's Waste Management Division (WMD) immediately, and take immediate steps to ensure both health and safety. The owner / operator must also place the incident in the operating record and submit a remedial plan to the WMD, and submit an emissions monitoring plan to the ARD in accordance with the NHDES Landfill Gas Policy.

Certain landfills, due mostly to past development practices, have a higher likelihood of exhibiting gas migration problems than do others. When designing plans for landfill closure, it is important to identify situations which may cause exceedences as noted above. The following is a list of considerations used by the WMD during landfill closure plan reviews:

- Methane will travel either upward, if it is not hindered in some way, or it will travel laterally under pressure. If gas is trapped within the landfill and cannot escape upward, it will build up pressure until it is forced out, always by the route of least resistance. Passive vents in a cap may not always provide the easiest route for gas to travel.
- Determine the setting in which the landfill was placed (e.g. wetlands or gravel pit). Wetlands can restrict and divert gas flows to unusual directions. If the landfill is in a gravel pit containing very pervious soils, then one must be alert to possible changes in gas migration pathways, which can be significant when ice and snow cover restricts simple passive venting and allows gas pressures to build, causing lateral migration of the gas.
- Of particular interest are landfills that are partially surrounded by wetlands or a high water table and have permeable soils on the dry side, usually at a substantially higher elevation. The side with permeable soils is particularly vulnerable to gas penetration because all the gas must either get out by way of the vents or through the soil which has been restricted. Attention must be paid to these areas, which must often be managed through the use of a greater concentration of vents and monitoring probes.
- Look for previous fill patterns which could contribute to a gas migration problem. One situation in particular is found where waste is piled against the side of an old gravel pit

such that the waste is deep right at the edge of the pervious gravel. This makes it vitally important to obtain accurate landfill profiles.

- In the test pit logs, look for strata within the waste mass (i.e. compacted low permeable soils used as intermediate cover or access roads) which may interfere with the upward flow of landfill gas and cause high pressure pockets. If there are lots of leachate breakouts on the side slopes, chances are there are restrictive layers within the landfill that are not only preventing the downward flow of leachate but could restrict the upward flow of gas. Also, consider what is being done in the actual closure construction in this regard. Make sure a restrictive situation is not being inadvertently created.
- Identify nearby underground utilities, such as sewers, which may become a conduit for gas transmission. Special steps may need to be taken to protect them.
- Identify all structures within 1000 feet of the landfill, and pay particular attention to those located uphill. Identify where onsite wells and septic systems are in relation to the potential path of gas migration.
- Look for surfaces, such as pavement, adjacent to the landfill which can contribute to farther-than-expected migration of gas, and assure that protection/monitoring occurs beyond any restrictive surface.
- Make sure the gas monitoring plan indicates how often, and when, gas monitoring is to be performed and has a clear plan of action conforming to the NHDES Landfill Gas Policy if gas concentration exceedences are found at the property line or in structures.

Control of Emissions - Air Resources Division and Clean Air Act Requirements

Besides large quantities of methane, landfills also emit non-methane organic compounds (NMOCs) into the atmosphere to a lesser degree. Significant releases of NMOCs cause local air quality degradation, contribute to the formation of ground-level ozone and are themselves greenhouse gasses. Therefore, beyond the issues of safety at large landfills, there is a need to control landfill gas due to its potential to cause air pollution. The following is guidance on how to comply with state and federal air quality regulations at MSW landfills:

All landfills that accepted waste after November 8, 1987 and received a permit from the WMD to construct, modify or reconstruct prior to May 30, 1991 are classified as "existing landfills" and are regulated by the Emission Guidelines (EG) established by 40 CFR 60, Subpart Cc and ARD Rules Env-A 3400. All landfills that commenced construction, reconstruction or began accepting waste on or after May 30, 1991 are classified as "new landfills" and are regulated by the New Source Performance Standards (NSPS) established by 40 CFR 60, Subpart WWW. The two programs have similar requirements which are as follows:

- For landfills with in-place plus permitted capacity of less than 2.5 million Mg (2.75 million tons), the owner / operator must submit at least one Design Capacity Report to the ARD within 180 calendar days after the effective date of Env-A 3400 of the ARD Rules for existing landfills and in accordance with 40 CFR 60, Subpart WWW for new landfills. The Design Capacity Report must be updated as necessary.
- For landfills with in-place plus permitted capacity greater than 2.5 million Mg (2.75 million tons), the owner / operator must submit a Design Capacity Report and an Emissions Report for NMOC's in accordance with Env-A 3400 for existing landfills and with 40 CFR 60, Subpart WWW for new landfills.
- For landfills with in-place plus permitted capacity greater than 2.5 million Mg (2.75 million tons) and NMOC emissions greater than 50 Mg per year, the owner / operator must submit a Design Capacity Report, an Emissions Report for NMOC emissions, complete Design Plans, and install controls.

For the landfill owner / operator, the primary difference between EG and NSPS is the schedule for compliance. EG landfills must be in full compliance by January, 2000 and NSPS landfills must be in full compliance by December, 1998. To calculate NMOC emissions, the landfill should use EPA's "Landfill Air Emissions Estimation Model", or the equivalent equations, as a first cut. The more conservative Tier 1 (Clean Air Act) default values for methane generation rate, methane generation potential and NMOC concentration should be used to determine applicability to the federal EG or NSPS. As a further level of analysis, actual NMOC emissions obtained from testing at the landfill can be used if available.

Regardless of a landfill's EG/NSPS status, all must perform NMOC emission modeling for the State's VOC RACT (Reasonably Available Control Technology) and Air Toxics Programs. For these state-run programs, the more realistic ARD-approved AP-42 default values may be used. A MSW landfill emitting 50 Mg per year or more of photochemically reactive VOCs (as listed in ARD Rule Env-A 1204) triggers VOC RACT regulations. Under this program, control and destruction of landfill gas will likely be required.

Under the state's Air Toxics Program, sources must show compliance with ambient air limits (AALs) established by ARD. This is done by means of a computer dispersion model which predicts the maximum concentration at and beyond the property line. An air permit is required if any AALs are exceeded.

Future regulation of air toxics may also be applicable under Title III and Title V of the CAA of 1990. Title III, which contains the maximum achievable control technology, is expected to take effect in the year 2000 for MSW landfills. Also, if a MSW landfill emits greater than 10 tpy of any one of the 189 listed hazardous air pollutants, or 25 tpy of any combination, Title V will be applicable. In this case, controls are likely needed to reduce emissions to below the Title V applicability thresholds.

A landfill with controls, such as internal combustion engines, may be nitrogen oxides RACT applicable if emissions exceed 50 tpy.

Using the NHDES Landfill Gas Policy

The Department of Environmental Services developed the NHDES Landfill Gas Policy in 1995 to aid owners and operators of MSW landfills in complying with both CAA and RCRA Subtitle D requirements as they planned for the closure of their landfills. Since NMOC sampling is difficult and expensive, while methane detection is a relatively simple and common practice, and since landfill gas is comprised of approximately 50% methane, the policy allows post-closure monitoring of gas emissions to use methane as an indicator of landfill gas at the property line in both the soil and breathing zone. The policy is designed to use NMOC emissions calculations (AP-42) prior to closure to obtain an estimate of emissions and to decide if any of the above ARD programs apply to the landfill. This is followed up during post-closure, by monitoring the methane concentration at the property line as indicated above. In this way, the NHDES Landfill Gas Policy uses the RCRA D methane monitoring program to set trigger limits for site specific CAA air monitoring for NMOC's and other air toxics. The limits set in the policy are 10% LEL of methane in ambient air (breathing zone) or 50% LEL of methane in the soil gas at the property line. If these limits are exceeded, the landfill owner / operator must notify WMD and institute corrective action to protect public health and safety and submit to the ARD a proposed landfill gas monitoring plan to quantify actual NMOC emissions. Depending on the results of actual testing, one or more of the above described ARD programs may become applicable.